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EDITORIAL

On these pages the editor offers his opinions, unshackled by advertising patrons and unrestrained by anything save a sense of the decent and the truthful—the editor, alone, is responsible for their type, their tone and their tenor.

AN OMER FULL OF MANNA

"And Moses said unto Aaron, Take a pot and put an omer full of manna therein, and lay it up before the LORD, to be kept for your generations."

"Now an omer is the tenth part of an ephah."

SO is recorded in that greatest history book of all time, an early evidence of man's museum instincts—an early manifestation of an outgoing generation's desire to invest its tomorrows with tangible teachings, tied to the past. So too is recorded a classic reference to the ten-fingered trick of metrology, something of a primitive decimal system which we moderns erroneously regard as recent and contemporaneous with the fall of the Bastille.

Elsewhere, and just about at the same time that Moses was in conference with Jethro, his Midianite father-in-law, whose flocks of sheep dotted the plains below Mount Horeb, there was being written, on the sun-baked banks of the sinuous Nile, another museum piece "to be kept for your generations."

This was a lengthy scroll, of one hundred and ten pages, or columns, and sixty-eight feet long, meticulously inscribed, the *rubrics,* and special characters, done in vermilion, which today, four thousand years afterward, riles the retina with its screaming redness. The hieratic characters, each item chiselled in its place with fine delineation, are as clear today upon their sere mat as they were when the pale and patient scribe dipped his pen in ethiopic ink, and deftly, boldly made the mute papyrus a pageant for posterity.

That was nearly forty-five centuries ago, and in a museum, jealously guarded, at the University of Leipzig, now rests this ancient manuscript, "The Ebers Papyrus," fortieth of the Hermetic Books, the book of Remedies, and actually the most ancient book in the world.

And the scribe was a man (even as you and I) who broke covenant with the monotony of his cuneiform rote and occasionally reacted with a humorous, human rash.

For instance, listen to the conceit of this:—"Whom God loves he quickens. I am one whom God loves, therefore he quickens me."

And one need not believe from the records of this papyrus of old that constipation was a modern disease, for here is its testimony as to a way "to drive out the excrement from the body of a person."

Consider this prescription from the Ebers Papyrus,—

"Berries-of-the-Castor-tree.
Chew and swallow with Beer in order to clear out all that is in the body, that should not be in the body."

Elsewhere is a medicine, not unlike in intention to that modern concoction, for which children cry, and yet in this ancient papyrus, paradoxically labelled a "remedy to stop the crying of a child."

Powder-which-contains-opium,
Fly-dirt-which-is-on-the-mummy.
Mix in the child's mouth—IT ACTS AT ONCE!

So, also, did Mother Winslow's Soothing Syrup, with its Morphine lullaby, many centuries later suit an unmotherly mother's intent. And, we moderns, who coined that obstreperous word "halitosis," and so conceded our own originality, will be susprised to note that Egypt anticipated us by at least four thousand years.

In this way:

Dried Myrrh,
Incense,
Cyperus,
Sebet-resin,
Calmus-from-the-land-t'ahi-in-Asia,
Inekuun grain,
Mastich,
Styrax.

Crush, grind, conjoin and fuse with fire. Fumigate with them, or else make mouth-pills wherewith to make the smell of the mouth acceptable! Listerine, to the contrary notwithstanding.

But the unchangeableness of human nature, is best demonstrated, perhaps, by the array of "hair tonics" exhibited in this ancient compilation.

The man has yet to be born who will not be thrilled by learning that the very first remedy for baldness recorded by history was prepared for a mere woman, although a Queen at that!

This was it,—

Toes-of-a-Dog,
Faeces-of-Dates,
Hoof-of-an-Ass, equal parts.

This was prepared as a hair invigorator—a hairy persiflage—for Ses, Mother of his Majesty, the King of Upper and Lower Egypt, Teta, Deceased—just fifty centuries ago.

And, more than likely, Ses capitalized by its ministration as unprofitably as does any commuter today who receives a generous sprinkling of someone's nap-inciting tonic in Gus' barber shop.

And so might we continue in merry quotation from this, the most ancient of all human books, to prove that human practices change, but human nature never.

Yet, withal, must we admit that not for nothing have fifty centuries of progress and research come and gone.

And not for nothing does this current generation fill its omer full of manna, just to prove that an omer is the tenth part of an ephah, but rather to remember, that tomorrows after all, are no more, and no less, than the sublimates of yesterdays, however lived.

IVOR GRIFFITH.

The Effect of Roentgen Rays on the Colloidal Properties of Erythrocytes. Helen Quincy Woodard. *J. Physical Chem., 42,* 47 (1938). The author studied the effect of 200 kv. Roentgen radiations on the osmotic properties of sheep erythrocytes. It was found that the susceptibility to hemolysis of erythrocytes which were irradiated when fresh was increased by irradiation; however, this effect was reversed when the cells were irradiated after they had been kept in physiological saline for several days at low temperatures.

Briefly the results are interpreted as meaning that the hemoglobin of fresh cells is split to compounds of smaller molecules by Roentgen radiation, while that of aged calls is coagulated.

L. J. K.

ORIGINAL ARTICLES

BIOCHEMISTRY OF SILICA

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In the arts and industries, Silicon has been a much appreciated element, its various forms having been for ages in the service of man. Its biochemistry, however, has been neglected. The authors have compiled, in this article, a fine survey of the present knowledge in the field.

I. Introduction

ALTHOUGH the element silicon is, next to oxygen, the most abundant element known, constituting the greater portion of the earth's crust, comparatively little attention has been paid to its distribution and properties in plants and animals. Not until comparatively recently have the industries as well as medicine begun to appreciate the possible uses and the actual value of the element and its compounds.(1)

It is our purpose to consider: 1) the detection, isolation and estimation of silicon in animals and plants; 2) the determination of the character of its combination in animals and plants, whether organic or inorganic. The information contained herein was obtained through investigation of the literature and through experimentation.

II. History

Silicon, like all substances on this earth, plays a definite part in the organization of the world. Present in the earth as silica (silicon dioxide, SiO_2) or sand and complex silicates of many elements, silicon is probably absorbed as the silicate ion. It is a known fact that silicon is contained in almost all existing plants and animals, even though it be there in infinitesimal amounts. There, it plays a part in the physiology of the plant or animal containing it.

Tabaschir, described by Dioscorides and used as a drug in the Orient, is a substance obtained by injuring the trunks of a species

*From the Biological Laboratories and The Gross Laboratory for Biological and Biochemical Research.

of Bamboo grown in Java. At the point of injury a watery fluid, rich in silicic acid, exudes. On evaporation of the water a solid siliceous residue remains.(2)

By means of its silica skeleton Cyperus esculentus(3) was detected in the intestines of Egyptian mummies six thousand years old.

Equisetum hiemale has long been used as an abrasive for which it is fitted by the siliceous character of its stems. Equisetum arvense was long ago recommended by Dioscorides and Plinius for internal use in diseases of respiratory organs, in treatment of tuberculosis, in bleedings of all kinds and as a diuretic; for external use in wound treatment. In the middle ages it served as a household remedy and in modern times homeopaths like Hahnemann and naturopaths like Father Kneipp considered it among the excellent drugs. Other silicon plants, such as Polygonum aviculare and Galeopsis ochroleuca were considered as a universal remedy against phthisis and the herbs are still used against lung diseases.

Alexander(4) in his work on colloidal chemistry, states that silicon is the substratum of life. Morse(5) states that were it necessary, silicon could replace carbon in nature.

Of the few organic compounds of silicon, Friedel and Crafts prepared several esters of silicic acid.

$$\begin{matrix} C_2H_5O & & O.C_2H_5 \\ & Si & \\ C_2H_5O & & O.C_2H_5 \end{matrix} \qquad \text{Ortho Ethyl Silicate}$$

$$\begin{matrix} CH_2O & & O.CH_2 \\ & Si & \\ CH_2O & & O.CH_2 \end{matrix} \qquad \text{Glycerinorthosilicate}$$

Drechsel isolated the organic silicon compound from goose feathers by extracting them with warm alcoholic ether and cooling. A separation took place and the sediment proved to be the ortho silicic ester of cholesterol, Si (C 34 H 59 O) 4, and its homologues. This preparation, having a melting point of 52° C., is lighter than chloroform and heavier than alcohol.(6)

III. Occurrence

Silica in Animals

Complex animals either get their silica directly from plant foods or indirectly from other animals who had consumed plant food.

Aquatic animals no doubt take in soluble silicates as well. Hairs and feathers, blood, milk, and the various tissues of organs, as the brain, the liver, and the glands, have been found to contain silicic acid; even urine, feces, the skin, or eggs, both in the albumen and in the yolk, contained upon analyses of many workers silicic acid. It is an integral part of the connective tissue which contains larger amounts in young than in old individuals. There is definite evidence that a certain minimum amount of silicic acid is required by the organism; however, the mechanism, whether inorganic or organic combinations occur in the body, is still obscured. Tissues definitely will store silicic acid in some form. We found it together with the peculiar substance chitin in the crustacean daphnia and have some indication that it also occurs in the mandibles of the same animal.

As will be illustrated by the following tabulation, silicon is widely distributed in the animal kingdom and is present in most of the organs of the body.

The following is a compilation of the results obtained by Gorup-Besanez, Baudrimont, Kunkel and Hall, Weber, Witting, Stolzel, Oidtmann, Schulz, Koningk-Wurzer, Pflug, Liebner, Ritner, Dammamm, Gonnermann, Strigel, Bley, Siegfried and Kobert in their investigations of the quantitative distribution of the element in animal substances.

TABLE I.

SILICON CONTENT OF ANIMAL SUBSTANCES.

Substance	% of Si in ash	% of Si in substance
Goose feathers		1.47
Pigeon feathers		1.19
Stork feathers		0.94
Hen feathers		0.20
Sheep wool		8.30
Dog hair		12.50
Hog hair		9.40
Horse hair		14.60
Ox hair		10.80
White fabric hairs	9.52-12.3	
Brown fabric hairs	13.89-30.66	
Black fabric hairs	6.6	

Substance	% of Si in ash	% of Si in substance
Blond fabric hairs	30.72	
Red fabric hairs	42.5	
Human Hair		0.1 (average)
Oxblood	1.11	
Cow's Milk	0.06- 0.09	
Oxflesh	2.07	
Calves' flesh	0.81	
Sheep horns	71.0	
Oxgall	0.36	
Daphnia*	0.982	0.0875
Human male liver	0.27	(dried) 0.0115
Gall stones	0.125	
Human skin		0.0051
Female liver	0.72	(dried) 0.03
Liver of newly born syphilitic	0.176	(dried) 0.009
Thymus gland of child	8.04	
Pancreas		0.1-0.2
Silicosis of lung		3·5-33·7

The organisms lowest in the scale of life contain the greatest amount of silica. The diet is another influencing factor. It has been found(5) that in animals, whose diet consists of plant substances, there is a greater amount of silica present than in those that are carnivorous.

The Estimation of Silica in the Daphnia

The most satisfactory and quickest method was found to be the use of the sodium silicofluoride reaction after ashing the animal; for the detection and the estimation was carried out as in Equisetum.

The ash yields 0.982 per cent., the animal 0.0875 per cent. of silicon.

The absorption of silicic acid and the organs that are responsible for its absorption are not as yet clearly understood. The determination of the character of the combination of silica with animal and vegetable tissues is therefore of great interest from a therapeutic standpoint.

*Original data.

Silica in Plants

The distribution of silica in plants is even wider than in animals. Silica is predominant in the cell walls of many plants. Silicified membranes are distinguished by their hardness and rigidity, and are capable of growth themselves.

The lowest forms of plant life studied were Diatoms. The shell of Diatoms is rich (87 per cent.) in silica which is in combination with the substance that makes up the skeleton.

In the nutrition of Diatoms an optimum concentration of $K_2Si_2O_5$ between 0.031 and 0.063 per cent. is found for Fragilea, Navicula and Witzchinia, there being an optimum for each species. The harmful effects of higher concentrations are due to "OH" ions. Soluble silicates appear to be necessary as there are only a few species that will decompose SiO_2. The silicates are absorbed and deposited in the shell as a complex organic compound. The mature cell can neither be distended nor dissolved by the organism.(7)

The cell sap of plants contains many elements either free or in combination. They are carried into the plant with the transpiration stream, in which they are dissolved, whether or not they are needed by the plant for its nutrition. From a standpoint of relative value as a raw material for plant food they are divided into three classes.(8)

1. Non-essential elements—
   - Silicon
   - Aluminum
   - Sodium

2. Essential and abundant—
   - Magnesium
   - Calcium
   - Iron
   - Sulfur

3. Critical elements—
   - Nitrogen
   - Potassium
   - Phosphorus and Sulfur (possibly)
   - Iodine (sometimes)

From this subdivision it can be readily seen that silicon according to a general belief is not essential to plant life. It is probably absorbed as the silicate ion and deposited, after loss of water, in the cell walls of cuticular membranes as an incrustration of silicon dioxide or in organic combination with cellulose or both.

Many writers, considering the silicon in inorganic combination, claim the deposition to be a separation of nonassimilable material, as most silica containing plants are found in a sub-tropical or tropical region where the silica or silicic acid content of the soil is high.

Silicic acid is found in ergot, and especially abundant in Equisetum species and the grasses, the ash of sugar cane, the Cyperaceae, Urticaceae, Aristolochiaceae, Euphorbiaceae, Compositae, Cucurbitaceae, Chrysobalaneae, and Ericaceae.

The cuticular membranes of the epidermal tissues of trichomes are rich in silicic acid, sometimes an entire membrane being silicified, or sometimes silicified cell group compose the border cells of trichomes. The openings and excretion canals of the Myrtaceae are strongly silicified. In rare cases the cork cells of Liquidambar and Elaterium are silicified. The trichomes of Digitalis adulterants, namely, Inula species, Symphytum officinale, are silicified. Digitalis trichomes are not.

Less often silicic acid excretion is found in the interior of the cell either free in the lumen or attached to the cell wall (See illustration No. IIa.) In the Aristolochiaceae sometimes large silica bodies are found, the central non-layered mass being silicified and not giving any cellulose reaction.

Crueger(3) observed the layered, double refractive, opalescent silica bodies in the cortical parenchyma of Moquilea, reaching into the finer pith canals and intercellular spaces. Mohl(3) found similar formations in the leaves of Magnolia glauca, Licania crassifolia, Davilla brasiliana, Hirtella racemosa, Mirbelia nilagirica Zenk.

Silica bodies are found in the wood parenchyma and medullary rays of Petrea volubilis; the trachea of Petrea arborea are silicified, Silica bodies occur in the leaves of Chrysobalanus icaco, Hirtella punctata Miq., Davilla radula Mart., in Hymenophyllaceae, in Palms, Moraceae, in the leaves of the Podostemaceae (epidermal and subepidermal cells and trichomes), in the wood and parenchyma of the Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Burseraceae and Anacardiaceae.

Although silica bodies occur predominantly in the leaves they also occur in fruits and seeds. The silica bodies found in certain parts of seeds are found in the corresponding vegetative parts of the plant.

The peculiar hairs of Urtica, Laportes and Loasa are characterized by extraordinary rigidity and fragility on account of mineralization of the membrane through silicic acid, calcium carbonate or both.(2)

Many palms and orchids contain stegmata or cover cells. These are small warty bodies found near the bast fibers. (See illustration No. I.)

TABLE II.

SILICON CONTENT OF SOME PLANTS AND MEDICINAL PRODUCTS.(6)

Substance	% of Si in ash	% of Si in substance
Equisetum hiemale*	69.36	11.84
Amomum Globosum (seed)*	6.4	1.4
Elattaria Cardamomum (seed)*	75.0	2.73
Cocos nucifera*	30.0	3.25
German Equisetum	70.0	
Ryestraw	50.0	
Sarsaparilla	32.5	
Belladonna	26.0	
Wheat	1.18	
Wheat Straw	67.9	
Laminaria sacharina	20.26	
Bambusa arundinacea up to	99.0	
Cauto Bark up to	98.0	
Conifereae up to	10.0	
Cedrela	30-50	

*Original determinations.

Probably all plants contain varying amounts of silica.

As a result of his work, reported in Tables III and IV, Gaudard(9) concluded that plants, storing silicic acid, must grow on a soil rich in silicic acid in order to store the maximum amount. The same plants, lacking this inflow of silicic acid, vary greatly in their content and may, in fact, be found to contain very little. The age of the plants is of especial influence as the fully developed plants are

altogether richer in silicic acid. It is obviously advantageous to collect silicic acid plants in the fully developed vegetative stage from sandy soil.

Besides Equisetum and Polygonum species, yielding typical silicic acid drugs, Phragmites communis, Zea Mays, Stigmata Maidis, Herba Urticae, Rhizoma Graminis, Rhizoma Caricis, Herba Avenae and other gramineae may merit consideration for silicic acid therapy.

TABLE III (9)

SILICA CONTENT IN PLANTS

Fresh Plant Material	Vegetation Stage	Total SiO_2 %	Sol. SiO_2 %
Arctostaphylos Uva ursi	Before Flowering	0.05	0.016
Avena flavescens	Before Flowering	1.52-1.70	0.09
Bromus hordeaceus	Before Flowering	1.34	
Carex arenaria	In Bloom	1.55	
Dactylis glomerata	Before Flowering	1.14	
Erica carnea	In Bloom	0.27-0.30	0.06
Fumaria officinalis	In Bloom	0.15	
Galeobdolon luteum	In Bloom	0.18-0.22	0.04
Juncus effusus	Before Flowering	0.48	
Lolium perenne	Before Flowering	1.04	
Phragmites communis	Before Flowering	7.66	0.08
Plantago lanceolata	Before Flowering	0.05	
Rhododendron ferrugineum	In Bloom	0.09	
Secale cereale	Before Flowering	1.12	0.075
Urtica dioica	Before Flowering	1.65	0.14
Vaccinium Myrtillus	In Bloom	0.10	
Vaccinium Vitis idaea	In Bloom	0.11	
Zea Mays	Before Flowering	1.49	
Dried Commercial Drug			
Fructus Phaseoli		0.06	
Herba Avenae		2.04-2.09	
Herba Parietariae		0.43	
Lichen islandicus		0.09	
Viscum album		0.07	0.016
Zea Mays	Before Flowering self-dried	1.49	0.19

The Silica Content of the Substances Studied

Equisetum hiemale

Total silica in stems	11.48 %
Silica in the ash	69.36 %
Water soluble silica	0.163%
Organic silica	4.3 %

TABLE IV (9)

SILICA CONTENT IN EQUISETUM ARVENSE

(*Fresh Plant, Washed, Amounts, Related to Dry Wt. of Plant*)

Date	Location	Soil	Height Vegetation stage	SiO_2 Total %	SiO_2 Sol. %	Remarks
April	Wood's edge	Sandy	Fertile form	3.21		
May 8	Wood clearing	Sandy loam	Sterile form 10-12 cm.	4.69	0.14	
May 30	Wood's edge	Sandy	Abt. 15 cm.	3.71	0.06	
June 10	River bank	Sandy	20-40 cm.	3.78	...	Only branches
				4.09	...	Only stems
				...	0.10	Total plant
June 24	Wood clearing	Sandy loam	Abt. 25 cm.	6.90	0.10	
July 23	Wood's edge	Sandy loam	full develop.	10.04	0.14	
July 23	Wood clearing	Pure loam	Abt. 25 cm. app. well developed	16.25	...	
July 27	Wood clearing	Pure loam	full develop.	15.31	0.33	
July 27	Wood's edge	Sandy loam	full develop. small	12.71	0.22	
July 27	River bank	Sandy	full develop.	6.20	0.10	
Aug. 23	Wood's edge	Sandy loam	full develop.	10.94	0.21	
Aug. 23	Own cultivation	1/3 earth 2/3 sand	small, strongly stunted	3.23	0.17	
1929		SILICA CONTENT IN EQUISETUM MAXIMUM				
June 10	River bank	Sandy	10-15 cm.	4.39-4.60	0.10	
Aug. 23	Wood's edge	Sandy	till 60 cm.	11.30	0.13	
		SILICA CONTENT IN EQUISETUM SYLVATICUM				
June 24	Wood clearing	Swamy wood soil	Ca. 25 cm.	8.23	...	

DIALYSATUM EQUISETI ARVENIS GOLAZ

Sol. Silicic Acid = 0.008.
After Kobert (10) = 0.009.

TABLE V (9)

SILICA CONTENT IN EQUISETUM ARVENSE (*Dried Commercial Drug*)

Source	Sand	Total SiO_2 %	Sol. SiO_2 %	Remarks
A. (conc.)	0.12-0.97	6.50-6.90	0.74-0.78	Filtered
(pulv.)	0.50-0.63	6.23-6.31		
B.	0.38	7.77	0.56 "2 mal"	Filtered
C.	Traces	6.34	0.50-0.52	Filtered
D.	1.601	5.19		
A.			0.22	In percolate
			0.71	Boiled three hours, eight days maceration with alcohol
			0.09	30%
			0.06	50%
			0.07	70%
Results given by other investigators and pharmacopœia				
Riedel, A. G. (11)		8.4		
Kroeber (11)		10.88	5.1721	
Baup (11)		6.38		
Kiefer (11)		6.02		
Möller (11)		4.3		
Schulz (13)			0.6	
Gerhartz & Strigel (14)			0.98	
Gonnermann (15)			0.73-1.80	
Pater (16)			2.40	
Pharmacopœia austriaca	12.00-13.60			
SILICA CONTENT IN EQUISETUM MAXIMUM (*Dried Commercial Drug*)				
A.	Traces	7.12-7.20	0.28-0.29	
B.	Traces	9.57	0.26	
C.	Traces	11.58	0.38-0.40	
Result by Pater (16)			2.20	

The estimation of organic silica by the method recommended by Nanji and Shaw(17) does not seem to be accurate as there is a possibility of alkaline hydrolysis. The tissue after treatment with the alkali solution still exhibits incrustations of silica.

TABLE VI (9)

SILICA CONTENT IN POLYGONUM AVICULARE

(*Fresh Plant, Washed*)

Date	Location	Soil	Vegetation stage	SiO_2 Total %	SiO_2 Sol. %	Remarks
Aug. 5	Potato field		Med. & large specimens	0.31	0.08	*On aging:* Silicic acid increases in plant
Aug. 14	Potato field differ.		Fully developed	0.13	...	
Aug. 14	Own culture	1/3 soil 2/3 sand	Small specimens	0.18	...	
Aug. 15	Own culture	Garden bed	Fully developed	0.23	...	Sandy soil is needed for its imbedding
Aug. 20	Own culture	Garden bed	Fully developed	0.24	0.05-0.06	
Sept. 2	Own culture	Garden bed	Fully developed	0.33	...	
Sept. 2	Own culture	1/3 soil 2/3 sand	Fully developed	0.23	...	
Oct. 2	Field for cereal weedy		Fully developed	0.37-0.40	0.13	
Oct. 21	Own culture garden bed		Fully developed	0.56-0.68	0.20 0.17	Sap cleared with albumen

SILICA CONTENT IN POLYGONUM AVICULARE

Source	Sand	Total SiO_2 %	Sol. SiO_2 %	Remarks
A.	0.3-0.4	0.99-1.08	0.10	Decoction crystal clear
B.	0.1	0.85	0.09 (2 mal)	Decoction crystal clear
C.	Not removed	1.50	0.07-0.09	Decoction crystal clear
D.	0.31	1.24	0.02-0.021	Decoction crystal clear
A.	...	...	0.20-0.24	Colated
Results by Kroeber (11)		4.50	1.309	
Results by Gonnermann (15)		...	0.34-1.40	

In Equisetum (arvense), recorded on Tables IV and V, the soluble silicic acid is present as a true acid in true solution, as albumen produced no precipitation. Gaudard believes it probable that true solutions of silicic acid are more effective than colloidal solutions. At least 0.5 per cent. of soluble silicic acid, obtained through boiling of the dried drug, appears to be required for the examination.

TABLE VII (9)

SILICA CONTENT IN GALEOPSIS TETRAHIT

(*Fresh Plant, Washed*)

Date	Location	Soil	Vegation stage	SiO_2 Total %	SiO_2 Sol. %	Remarks
June 22	Potato field		Before the flower	0.13 0.19	 0.07	Only stems Only leaves Total plant
Aug. 5	Wood clearing	Wood soil	Ca. 1 m. specimens	0.14 0.06 0.32	0.012	Total plant Leaves Only inflorescence after flowering
Aug. 5	Wayside	Sandy field soil	After blooming	1.21		
Aug. 25	Wood clearing	Humus soil	In flower	0.14	0.05	
SILICA CONTENT IN GALEOPSIS PRAECOX LINNÉ (*Fresh Plant, Washed*)						
June 18	Field with cereal wayside	Rich in sand	Mostly in bloom	0.28 0.84	 0.05	Stem Leaves Whole plant
July 5	Field with cereal dust free		Partly after bloom	0.20		
July 24	Field with cereal dusty		Partly after bloom	0.38	0.02	
Aug. 5	Potato field dust free		After bloom	0.19		
Aug. 14	Own culture	1/3 soil 2/3 sand	After bloom	1.65		

As usually only small doses are administered in silicic acid therapy, Equisetum deserves consideration as a natural source for silicic acid.

Polygonum (aviculare), see Table VI, contained considerable amounts of silicic acid which was found to be most abundant in the drug, collected at the end of October.

Galeopsis (ochroleuca and Tetrahit), as recorded on Tables VII and VIII, contained only small amounts of soluble silicic acid. This finding, at least tentatively, excludes Galeopsis from typical silicic acid drugs. Gaudard(9) believes it possible that the amount of soluble silicic acid is reduced as a result of prolonged storage of the drug through progress in hydration, transforming the simple soluble silicic acids into higher insoluble acids.

TABLE VIII (9)

SILICA CONTENT IN GALEOPSIS OCHROLEUCA (*Dried Commercial Drug*)

Source	Sand	Total SiO_2 %	Sol. SiO_2 %	Remarks
A.	0.03-0.08	0.88-0.90	0.02-0.06	Decoction filtered
B.	0.02	0.78	0.038	Crystal clear
C.	0.07	0.83	0.015-0.017	Crystal clear
D.	Traces	0.72	0.029	Crystal clear
A.			0.21-0.22	Pressed and colated
B.			0.12-0.13	Pressed and colated
A.			0.015	Cleared with albumen
A.			0.005	In the percolate
Results by Gonnermann (15)			0.0288-0.893	
Results by Kroeber (11)		2.89	0.452	

SILICA CONTENT IN GALEOPSIS VERSICOLOR (*Dried Commercial Drug*)

Results by Pater (16)	0.08

SILICA CONTENT IN GALEOPSIS LADANUM (*Dried Commercial Drug*)

Results by Pater (16)	0.28

IV. Functions of Silica

In animals, the function of silica seems to be limited to that of a protective agent. The lower animals and plants, especially the aquatic forms, contain a deposit of silica in the shell: Coral, Diatoms, Daphnia and many others contain this element in the shell.

In human beings, the amount of silicon in the body increases with age. It is therefore evident that it is absorbed. Based on the fact that silica is present in human tissues, silica have been used as

therapeutic agents in the treatment of gallstones, asthma, cough, tuberculosis of the lung and arteriosclerosis.

We have records of prescriptions such as the following in the Materia Medica of a few years ago.(6)

Natri silici sicci	10.0 Gm.
Adeps Lanae anhydric	10.0 Gm.

M. f. pillul. No. C. Consperge Terr. Silic
S. 10 to 20 daily.

The action of the sodium silicate in this preparation is to be exerted after its passage through the stomach on the basis of the theory that it is soluble in the pancreatic secretions.

In arteriosclerosis a purified sodium silicate is given by injection in quantities of one cc. of a 0.5 per cent. concentration, the maximum daily dose being 15 mg. of salt.

Another prescription is as follows:

Herbae Equiseti min.	75.0 Gm.
Herbae Polygoni	150.0 Gm.
Herbae Galeopsis	50.0 Gm.

1½ tablespoonfuls are added to two glasses of water and boiled till concentrated to one glassful. Such a dose is taken three times daily.

A decoction of this sort yields between 43 mg. and 277 mg. of water soluble silica and is used in tuberculosis.

The theory on which the use of water soluble silicates in medicine is based, is the fact that soluble silica is more active than colloidal silica, that organic silica is a normal constituent of epithelial structure of human tissues, and the medication, if absorbed, leads to the formation of a network in the lung tissue giving it strength and greater resistance against the attack of the organism.

According to Dr. Kobert, silicic acid is a normal constituent, occurring in an unknown organic combination in all connective and epithelial tissues of the animal and human body. As a result of tuberculosis the body more or less loses the ability to store silicic acid as is done normally, and also loses the ability to resist the destructive processes taking place in the disease. We have mentioned above that the resistance may be increased and the healing may be furthered by administration of silicious solutions or drug preparations. Patholog-

ical accumulations of silica, as of sand in the lung, leading to such dreadful conditions known as "silicosis" (see illustration No. IV), and usually death, due to tuberculosis, will be discussed in a special paper on lungs.(18)

In plants silica serves one or more of six functions.

1. As a strengthening agent.
   a. Affords support: as in various grains and grasses.
   b. Affords resistance
      Against strong water currents: Plants living in streams.
      Against hyphal parasitic fungi and cellulose destroying bacteria. SiO_2 renders plant membranes almost insoluble to micro-organisms.

2. As a protective agent.
   a. Present in plant hairs, giving them rigidity, thus enabling them to readily produce wounds as in Urtica, Laportea, and Loasa trichomes.
   b. Present in seeds as a protective covering of seeds of grasses, Calabar bean and many other seeds, or as a protection to the embryo, thereby aiding in the propagation of the species. As in Cardamom.

3. As a reflecting agent for light.
   a. Protecting against excess heat and absorbing radioactive substances. As in trichomes of Symphytum officinale.

4. For the conservation of water.
   a. Rochea falcata leaves contain large bladderlike cells lined with silica which act as reservoirs.

5. Silicates seem to lead to greater economy in the use of phosphorus and phosphates and appear capable of replacing them partly without detrimental effects to the growth of the plant. Barley straw obtained from plants grown in a water culture, with no added silica, yielded four to five times the normal quantity of phosphates (P_2O_5).(17)

6. As an essential factor in the soil frame work, silica (sand) added to clay and humus brings about the most satisfactory soil texture for plant growth, giving it pore space and aeration.(19)

V. The Quantitative Determination of Silicon (20)

Silicon, so abundant in the soil, either as silica or as a silicate, is likely absorbed as the water-soluble silicate by all plants. Some, as the grasses, absorb relatively large quantities. Liebig found in the ash of these "silicon plants" the following:

	Salts of Sodium and Potassium	Salts of Calcium and Magnesium	Silica
Oat straw and grain	34.00%	4.00%	62.08%
Rye straw	18.65%	16.52%	63.89%

While it is not altogether certain in what combination silicon is absorbed and circulated in the plant, and animal organism, whether in inorganic or organic form, methods have been worked out by various workers for the determination of the total, the soluble inorganic and the organic silicon. Gaudard(9) discusses the methods in considerable detail.

The most common, so-called "fusion method" for the gravimetric estimation of silicon depends upon volatilizing the silicon fluoride formed after treating the ash residue with hydrofluoric acid. The loss in weight is equivalent to silicon dissolved in this acid.

A. Determination of Silicic Acid in Fresh Material.

1. Total Silicic Acid.

After weighing, and washing (to remove adhering sand) and superficial drying, the material is quickly dried in the oven, reduced to a small volume and ashed.

2. Soluble Silicic Acid.

The same cleaned, superficially dried, material is cut and compounded to a mash in a brass mortar, repeatedly macerated for one-half hour with equal volume of water, which is removed each time after passing the mash through a press. The mixed press liquids are poured into a high graduate cylinder and silicic acid determined in an aliquot amount. Boiling the material with water is recommended particularly when juice is lacking.

B. Determination of Silicic Acid in Dried Drug.

1. Total Silicic Acid.

The white burned ash is lightly boiled for about 10 minutes with a little concentrated hydrochloric acid. This treatment opens

up and dissolves oxides and remaining salt particles. After rinsing repeatedly with water, collect this separately in an evaporating dish, until it runs off clear. The sediment is leached two to three times with saturated sodium chloride solution. The sediment, thus, when examined miscroscopically, should show only sand elements. The combined aqueous leaching liquids leave an acid residue on evaporation. This is mixed with dry soda powder and transferred into a platinum crucible, using little alcohol (contg. 10% HCl) in the final complete transfer of the remaining crusts. The silica is determined by fusion as usual.

2. Soluble and Colloidal Silicic Acid.

As a rule 50 grams of the herb or drug (e. g. Equisetum arvense) are boiled with 1½ pints of water for one hour. The liquid, running voluntarily through loose cotton, is stirred with 10 gm. iron-free paper pulp and the filtrate is poured back five to six times upon the paper pulp until the decoction is completely clarified.

Organic Silica (Quantitative): D. R. Nanji and W. S. Shaw(17) recommend the following method for the determination of organic silica.

Treat 2-3 gm. of plant to be tested with a 3-4 per cent. hydrochloric acid on a water bath for a half hour to extract acid decomposable silica. Filter, wash, and drain, then transfer to a platinum crucible and treat with a 5 per cent. solution of sodium bicarbonate to extract inorganic silica. Filter wash and determine residue for silica gravimetrically.

VI. Detection of Silica

The detection of silica requires the use of hydrofluoric acid. Apparatus used in this operation, if made of glass, would soon be destroyed by the reagent and would also render false results. The object slide therefore must be protected with a substance that is transparent and not attacked by the acid.

Slides coated with Canada balsam are transparent and are not affected by the reagent. The disadvantage lies in the fact that the apparatus must be prepared in advance in order to allow the coating to dry.

The writers have experimented with various shellacs, which were dissolved in an ammoniacal alcohol solution and the slides coated with

these solutions. The substances tried were: Manila Nibs, Bleached Shellac, Sandarac, Superfine Orange, XXXXX Kauri, No. L12, Ester Gum, Teglac Resyl, Congo Opal, Fancy Singapore, Bone Dry, and Amberol Salt.

Resistant slides made from one of the new transparent plastic resins may soon be available and well serve the purpose.

On subjecting these coated slides to the action of hydrofluoric acid none proved satisfactory; a method for carrying out the reaction was found to be on a slide coated with a thin layer of paraffine. After allowing crystallization to take place the crystals may then either be observed microscopically on the same slide or they may be dissolved in water and recrystallized on an unprotected slide. The advantage in the second method is that there is no loss of light due to the paraffine and the second crystallization gives well defined crystals that do not tend to clump together.

Sodium Silicofluoride Crystals (3): The section is placed on a paraffined slide, a few drops of a solution of sodium chloride are added, this is followed by a few drops of hydrofluoric acid—and crystallization carried out as described above; silica, if present, will give crystals of sodium silicofluoride. These crystallize in plates, stars, rosettes, prisms and pyramids, all in the hexagonal system.

To detect Dissolved Silicic Acid: A drop of the cell sap, pressed out on a protected slide and treated as above will give crystals of sodium silicofluoride.

Silica skeletons obtained through heating: In membranes containing silicic acid in large amounts, a skeleton showing the outline form of the original cell can be obtained through gentle heating. (See illustration No. IIb.) The composition of the ash, after driving off all organic matter, can be verified by testing its solubility in hydrofluoric acid according to the first reaction. In order that a pure white ash may be obtained and fusion with the alkalies present be prevented, the section should be first leached out with a mixture of hot nitric and hydrochloric acids, washed with alcohol and then heated.

Silica skeletons with Chromium Sulphuric Acid: Another and more satisfactory method for obtaining silica skeletons is by completely charring the section with sulphuric acid in a beaker, then adding a 20 per cent. solution of chromic acid. After some time the

organic matter is destroyed and the skeletons are transferred from this mixture into water, washed, collected by decantation and examined microscopically.

This method is satisfactory only in sections where the silicic acid content is high. Otherwise the sodium silicofluoride reaction must be depended upon.

Action of 5 Per Cent. Solution of Sodium Bicarbonate on Stems: On prolonged maceration in the 5 per cent. solution of sodium bicarbonate the epidermis becomes easily separated from the rest of the stem tissue. On microscopic examination the epidermis shows complete silicification. Special consideration is to be given to this tissue as it contains almost all of the silica present in the plant.

The Action of Hydrofluoric Acid on the Epidermis: The tissue becomes softened, loses its resistant properties, and on microscopic examination shows no clearly defined cell structure. Treated with chlorzinciodide it gives a cellulose reaction.

The Action of Copper Oxide Ammonia Solution on the Epidermis: This reagent dissolves any adhering cellulose and produces a clearly defined tissue.

The Action of Heat on the Epidermis: The tissue, treated as above to remove any cellulose, chars on ignition denoting the presence of organic matter.

The Effect of Potassium Hydroxide Solution on the Epidermis: This reagent dissolves the tissue. When the reaction is incomplete the remaining tissue gives a cellulose reaction with chlorzinciodide.

The Action of Cellulose Destroying Bacteria on the Epidermis: While the bacteria attack other portions of the stem, after seven months in a bacterial culture of Cyptophaga hutchisoni, Winogradski, the epidermis remained intact.

With Dye: Safranine, methylene blue, gentian violet, basic fuchsin and malachite green have been recommended as stains for silicified tissues. They are not selective and are taken on by the surrounding tissues, whether silicified or not.

Clearing Method: Thymol, rectified oil of turpentine, resinified oil of cloves and crystalline phenol may be used to clear the section. The most satisfactory method employs the last two agents named. It not only clears the section, but also gives a reddish hue to slightly or highly silicified membranes. It thereby serves as a means of detecting the finest silicifications. The section is placed

on a slide, covered with crystalline phenol and gentle heat is applied till the phenol is melted. The phenol is then replaced with resinified oil of clove and examined.

VII. Experimental Data

Equisetum hiemale, Equisetaceae: This plant, commonly known as scouring rush and horsetail, is an indigenous plant having slender annual stems from three to nine decimeters high and grows abundantly in the United States preferring wet places along the banks of streams, etc. It is of interest because of the high silicification of its stem, which yields an ash about 70 per cent. of which is silica. (See illustration No. III.)

This plant gives positive results with all the methods previously mentioned for the detection of silica.

Cardamomum: Both the seeds of Amomum Globosum and Elattaria Cardamomum contain small warty grains of silica, known as stegmats, deposited in the outer portions of the cells of the spermoderm. They are best detected by the use of the chromium sulphuric acid method which is confirmed by the production of crystals of sodium silicofluoride. The stegmata are completely soluble in hydrofluoric acid.

Fibers of Cocos nucifera: These fibers are each a fibrovascular bundle and have on one side small warty grains, known as stegmata, distributed at regular intervals. These may also be seen best by the chromium sulphuric acid method and are completely dissolved by hydrofluoric acid. (See illustration No. I.)

VIII. Summary and Conclusions

1. The largest amount of silicon is evidently found in fully developed plants grown on sandy soil.

2. Among the most prominent silicon plants, containing the therapeutically active, soluble silicic acid, may be counted especially Equisetum (arvense) and Polygonum (aviculare).

3. Silicon occurs either as silicic acid or inorganic silicates in the seeds of cardamom fruits and in the fibers of cocos nucifera,—inasmuch as the silica bodies, there present, are completely soluble in hydrofluoric acid.

4. Silicon occurs as silicic acid or inorganic silicates in Equisetum (hiemale).

5. Silicon probably occurs in the Equisetum epidermis also in an organic combination with the cellulosic material of the cell wall for the following reasons: the epidermal tissue, after prolonged treatment with freshly prepared copper oxide ammonia solution, in order to dissolve any adhering cellulose, and washing with water

a) was charred, upon heating,—proving the presence of organic matter;

b) became soft when treated with hydrofluoric acid, giving a cellulose reaction with chlorzinciodide;

c) showed considerable resistance to attack of cellulose destroying bacteria.

6. Daphnia magna yielded, undried, 0.0875 per cent. of silica, present in the mandibles, and probably also in the chitinous shell. The ash yielded 0.982 per cent. of silica.

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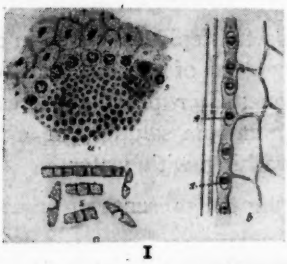
Silica in Plant and Animal Tissues



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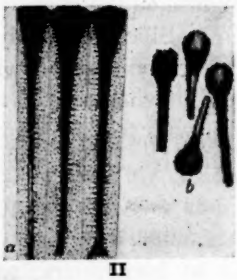

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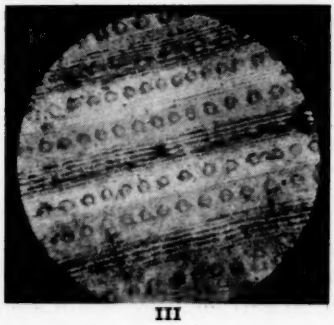

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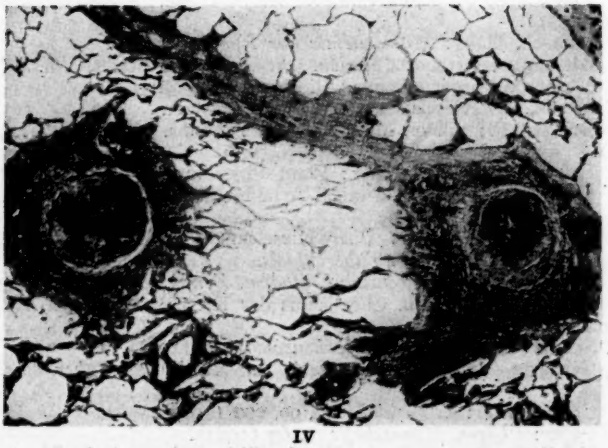

IV

I. Cells (Stegmata) filled with Silica bodies.
   a. Cross section through internal layer of cocoanut shell; s. Silica bodies.
   b. Longitudinal section through stem of a palmleaf (Phoenix sp.); s. Silica bodies.
   c. Isolated silica bodies from stegmata of Calathea Seemanni.

II. Silica cells from the internal layer of the stone nut (Phytelephas).
   a. Palisade-like silica cells, with silica in lumen and pores.
   b. Silica masses, after ashing of cells—after Molisch.

III. Silica, inorganically and organically combined, in membrane of stem epidermis of Equisetum (Scouring rush)—Original.

IV. Two silicotic nodules in the lung tissue of a granite cutter—after Gardner.

ARE WE ELEPHANTS OR MEN?

By T. Swann Harding
Falls Church, Va.

The author, known for his stream-lined thinking, offers, herewith, some startling and bold observations on certain developments in the field of nutrition.

IN JULY 1937 the International Association of Clothing Designers met in Rochester and made, or at least announced, a new and astonishing discovery. Men are getting as big as all outdoors. We no longer need say there *were* giants in *those* days. Soon it will be *these* days. Whereas the average adult suit size, the one most common, was a thirty-six a quarter of a century ago, it is now a thirty-eight. Moreover the average male height is five feet eight against five feet seven of twenty-five years ago.

There have been rumblings of this discovery earlier. The scientists have been fumbling over a lot of statistics and certain medical journals have expressed their consternation in editorials. They tell us that children who enter college these days are, again on the average, two inches taller and seven pounds heavier than their parents and grandparents who entered the same schools. What is more, this sort of thing has been going on for eighty years.

What has brought it about? Glands? Possibly. Better food? Well, we have all been getting just the kinds of food that make rats and guinea pigs grow fastest. Furthermore, a distinguished Chinese nutrition scientist some years ago attributed the relatively low weight and stature of his own race and of the Japanese to inferior nutrition. The same thing is said by some to hold for East India.

Of course various factors may be implicated. On the whole we do get better medical attention than our forefathers. We have made certain cultural advances. We are also better housed and sheltered. Our exercise habits have perhaps improved. Selective mating and occupational or even climatic changes may play a part. But modern nutrition science stands out prominently.

There is a general campaign for the encouragement of a greatly accelerated advance to mental and physical maturity. The infant diet is so arranged as to produce the fastest possible growth, while the modern educational system seeks to short-cut the route of youth to

intellectual maturity. Height and weight tables, and the inevitable I. Q. are set up rigidly, and infants or youths who do not conform lose caste.

If a child does not grow as fast as the table says it should, its parents and their friends are likely to decide that it is just no darned good for anything. No child can be too particular about its growth habits these days. But then some more thoughtful expert, like Dr. Walter C. Alvarez of Mayo Clinic, stops to ask whether all this growth acceleration is beneficial or ominous. Strangely enough, nobody can surely answer that question.

You would think that before shoving the young full of minerals and vitamins on the theory that these will promote growth we would first decide seriously what we meant by the word growth and second whether the kind of growth we mean is beneficial or the reverse. For growth itself is a word used carelessly. It may mean gain in weight, increase in height, progress to maturity, or any number of things but nutrition specialists and dietitians usually refer to increase in weight.

Sometimes one vitamin is singled out as *the* growth-promoting one although the more careful workers know and admit this is wrong. Any one of a considerable number of food elements will prevent growth if lacking from the diet and appear to promote it when fed again. But parents are quite generally encouraged to stuff into their offspring such diets as will produce maximum weight and height increase, with little thought as to the possible adverse effect of this procedure.

A very large percentage of the advertising not only in our popular magazines but in medical journals amounts to a laudation of growth. Eat this or drink that and attain that well-nourished look or grow quickly to adulthood as the case may be. Growth is in the air. Verbal magic abounds regarding especially fortified foods. Children who fail to increase in length and in weight at arbitrarily specified rates are regarded as abnormal by parents, teachers, and nurses alike.

Back of this rapid-growth assumption is the idea that the quick attainment of physical maturity is something greatly to be desired. Is it? What do we know about its ultimate effects in later life? The assumptions embodied in the doctrine are based upon works unnumbered—on rats. Technical journals abound with reports upon the promotion or retardation of the growth of the white rat by means of certain diets.

We can also read erudite reports upon lengthening the life span of white rats by feeding diets rich in certain nutritive elements. Yet there is scarcely an article in the entire literature upon the normal life span of this tireless animal. Its normal life span is not yet known! So when Dr. Henry C. Sherman declares that he has postponed senility and extended the "prime-of-life" period of rats by feeding them a longevity-promoting diet rich in calcium, vitamin A, protein, and vitamin G, we must pause before we accept the statement hook, line, and sinker.

Dr. Sherman says that his diet promotes a higher level of adult rat vitality and extends the length of rat life. He warns us that we should not place too much confidence in any estimate that transfers results on rats into human terms, but adds that if the transfer could be made safely the average span of human life would be increased from the present seventy to something like seventy-seven years—on his diet.

Anyway he is quite certain that the diet increased the life span of white rats 10 per cent. on the average. Indeed, he could produce that effect merely by adding milk to the rat's ration. The increase would be equivalent to six more years of life in human terms. But what is the normal life span of man? What is the normal life span of the white rat? We have no reliable information upon either question.

The white rat as bred (strictly speaking, inbred) for biological work is a highly unique and synthetic animal anyway. It is kept under very artificial conditions and its diet is highly purified. There is no telling just what a "normal" white rat would be or upon what stock diet it should be fed to attain its "normal" span of life. As to man, many factors enter in.

Man is a highly complex animal living in a very complex environment under a wide variety of conditions. Longevity statistics, except in quite recent years and then only in a certain few countries, are notoriously inaccurate. No experiments ever have been performed using standard methods and conditions and the closest kind of scientific control to ascertain the normal life span of either rat or man.

As little is known about "normal" growth of either rats or human beings. But assuming that there is some more or less definite thing as normal growth, is it wise then to feed young human beings a diet upon which laboratory white rats grow rapidly? We have also failed to find the answer to that question. It seems unfortunate that we

make pseudopractical applications of scientific knowledge so precipitously.

In a very broad way each animal species must have a sort of standard biological period during which it attains adult size and maturity. Is it wise to monkey with that orderly biological process? It amounts to varying one factor in a complex of various factors without knowing what we may accomplish.

Aristotle held that animals which live long must always be expected to take a longer time in maturing than short-lived animals. He thought nature better take care of such matters and they should not be hurried. He held that the period of immaturity was closely related to the life span as a whole. When we promote precocious maturity by dietetic or other means we may be playing with fire.

Roger Bacon in his "Opus Majus" declared that the span of human life then seemed to be decreasing. But he added that the best advice about diet and health was then disregarded by the multitude. Three centuries later Lord Francis Bacon wrote that "to grow long and slowly is a sign of longevity . . . but on the other hand rapid growth to great stature is a bad sign." He recommended a spare diet in youth to promote longevity.

In 1906 Jean Finot was writing that the prolongation of life definitely depended upon the duration of adolescence; hence any factors tending to extend the period of immaturity also tended to prolong life. Yet, he continued, "All the education and instruction given to children is in violent contradiction to this law. All our efforts tend to the most rapid advancement toward physical and intellectual maturity."

This continues today. Is it wise? Does undereating, especially in youth, tend to prolong life?

Metchnikoff thought that Bacillus Bulgaricus milk produced the numerous centenarians in the Balkans. But he was twice wrong. For one thing Balkan vital statistics were notoriously unreliable and for another the particular bacillus would not set up permanent housekeeping in the human intestine.

Read the obituaries of very old people or the stories given by them to the press as they pass a ninetieth, ninety-fifth, or a one-hundredth birthday. The advice they give to promote longevity is as diverse as it is often humorous. If some of them attribute their great age to moderation in all things and life-long temperance others declare

that tobacco, drinking, high living, eating what they pleased, and violent outbursts of anger have prolonged their lives.

But deprivation of food in youth is rarely if ever cited. Yet there is some scientific reason to think it may contribute to a long life. At least Dr. C. M. McCay claims to have doubled the apparent life span of laboratory rats by feeding them sparsely when young. The comparison was quite faithful as exactly similar rats normally fed the usual laboratory diets were used as controls.

The rats whose lives were thus prolonged appeared to be in an excellent state of preservation long after their fellows on a more normal laboratory diet had died of old age. If there is biological basis for the assumption that an animal's total life should be from six to seven times as long as its normal period of immaturity, we shorten the latter at our peril. Undue acceleration of growth in youth may, for all we know, actually tend to shorten the life span.

We do not know that these children who are so carefully fed all the growth-promoting foods turn out to be better adults, and more resistant to diseases, than others not fed them. We do not know whether they live shorter or longer lives than normal because we have a very vague idea indeed as to what normal is.

The life span of a laboratory rat we do know depends upon its intake of calories and of protein, as well as upon the temperature and humidity. Temperature always tends to affect the rate of living. While the life spans of experimental animals do undergo great apparent increases under certain conditions—especially when they are kept on certain rations—that is about all that is definitely known.

Scientists generally regard five to six hundred days as the normal life span of a rat kept and fed under usual laboratory conditions. It is possible, if growth and progress to maturity are controlled by dietetic means—in particular if the animals are sparsely fed in youth—to expand this apparent life span to twelve hundred days. But this doubling of the life span was accomplished by precisely the opposite method we use on human infants!

Is growth stunting beneficial then? The poorly nourished child is usually described as lethargic, dull, nervous, mentally apathetic. It suffers from muscular inertia and an inability to make sustained effort. Yet the grossly undernourished men from the city slums made the very finest and most courageous soldiers in the Great War when properly fed and placed in a changed environment with perhaps a

better exercise schedule. No permanent damage seemed to have been done them.

Some animals actually seem to be superior, from the standpoint of resistance to disease and ability to perform work, if well fed and well conditioned after a relatively long period of dietetic stunting. White rats stunted by underfeeding prove superior to more normal animals in learning new problems and in relearning old ones, the measure of performance being their speed and accuracy in running through a fairly difficult maze. The underfed rats are also more active than the well-fed ones, though the latter exceeded in accuracy in some tests.

Rapid growth may be pernicious. Certain bacteriologists, as a result of their work with minute organisms, point out that "slow growth should lead to a more perfect adjustment of an organism to its environment and, therefore, to greater viability". They mean by that last greater ability to persist in living despite adverse conditions.

They found, for instance, that certain bacilli would grow thirty times as fast at 45 degrees Fahrenheit as at 10 degrees. But while the bacilli grown at the lower temperature could live and reproduce at the higher one, those which grew so rapidly at the higher temperature practically all died immediately they were exposed to 10 degrees. Hence there was greater hardiness in the organisms that grew more slowly and under adverse temperature conditions.

It has been shown that trout live longer when fed diets low in protein. Diets that will merely maintain both insects and rats, and will permit them to grow only very slowly if at all, have been found to prolong their lives. The more some of these organisms eat apparently the quicker they burn themselves out and die. That is because their rate of living is directly associated with the quantity of food they eat.

This is the case with the water flea, which is not a flea at all but a minute animal related to the lobster. The fleas will live twice as long as usual if their food intake is reduced. They do not grow as large as the fully fed fleas but neither do they shrink with oncoming age as do the others.

The above-mentioned trout also lived about twice as long as usual when certain dietary essentials were sharply pared down. Rats fed a diet deficient in protein and in calories improved in longevity. Maturity was thus retarded. Finally the rats were permitted to grow at the time when they would normally have completed their customary life span. Then they still had a long life before them.

All this work is suggestive if not conclusive. The fundamental problem remains to be attacked and can hardly be solved quickly enough. Meanwhile we go on feeding the young growth-promoting diets. Child specialists set great store by height-and-weight tables and children are considered normal only insofar as they conform to the statistics.

If a child is not growing as rapidly as the tables say it should it must be stuffed with growth-promoting substances. Yet such a thing as ideal human growth standards does not exist. Child welfare is placed entirely too much upon a size-and-weight basis. The "overweight" so often reported may be disadvantageous; it may represent an approach to some ideal of men of great stature in the not very distant future.

Most experts claim that our existing weight-and-height standards are far too low. By what do they presume to judge? Is there some peculiar, outstanding advantage in increased stature and weight? Such evidence as we have is fragmentary but it seems to point the other way. Certainly it proves enough to make it definitely unwise for us to persist in advocating growth promotion indiscriminately.

One child not long since soured on this doctrine apparently. After being told for perhaps the thousandth time to eat this or drink that to make him grow he revolted and asked: "Do you want me to be an elephant, mamma?" When she stopped to consider the matter the mother decided she would rather not have that happen. It is high time that we all stopped to ponder that ominous possibility.

A Practical Study of Procedure for the Detection of the Presence of Coliform Organisms in Water. H. MacCrady. *Am. J. Pub. Health, 27,* 1243 (1937). Over 1200 water samples from which lactose broth presumptives were obtained, were examined for coliform organisms. Five confirmatory methods were used: the "completed test" of standard methods of water analysis, brilliant green bile, crystal violet, fuchsin and formate ricinoleate broths. Fuchsin broth was also used as a primary medium in the examination of approximately 900 of the above samples. The lactose broth and the brilliant green bile confirmatory methods are favored. L. G.

ABSTRACTS FROM AND REVIEWS OF THE LITERATURE OF THE SCIENCES SUPPORTING PUBLIC HEALTH

Bacteriology . . . . Louis Gershenfeld, B. Sc., Ph M.
Biochemistry, Nutrition, etc. . . . Arno Viehoever, Ph. D.
Biology . . . . . Marin S. Dunn, Ph. D.
Chemistry . . . . . Arthur Osol, Ph. D.
Pharmacy . . . . . E. Fullerton Cook, Ph. M.
and their assistants

PLANT GROWTH IN NUTRIENT SOLUTION AND SAND CULTURES

A Review

By Isadore Cohen, Ph. D.
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In the past few months, public interest has been aroused through several newspaper articles and a movie short dealing with the method of growing plants without soil. This is by no means a new technique for it has been the standard experimental method in use by plant physiologists for studying the nutritional requirements of plants.

Fundamentally, there is no difference between plants grown in soil or plants grown in water, for in the first case the plants are also actually growing in water. It has been known for over three-quarters of a century that plants obtain the mineral elements necessary for growth from the soil solution by way of the fine absorbing roots. This soil solution is formed through the solvent action of rain water upon the soil particles and organic matter. There is always a film of the soil solution around the absorbing roots of the plants, for in its absence no passage of mineral elements can take place. A necessary balance of the minerals in the soil solution, proper aeration of soil and acidity or alkalinity favors best growth.

Whereas it is difficult to maintain controlled conditions in natural soils, this difficulty is eliminated by the water culture method since

the nutrient can be changed at will, thus assuring the proper balance of salts.

Detailed information dealing with the nutritional requirements of plants may be obtained from "Plant Physiology" by Edwin C. Miller (McGraw-Hill) while in the two publications cited here experimental and practical data is presented:

1. Methods of Growing Plants in Solution and Sand Cultures, by J. W. Shive and W. R. Robbins. Bull. 636, Nov. 1937, N. J. Agr. Expt. Sta.

2. Nutrient Solution Methods of Greenhouse Crop Production, by R. B. Withrow and J. P. Biebel. Circular 232, Nov. 1937, Purdue University Agr. Expt. Sta. Most of the material given here has been abstracted from these publications.

Solution Culture

The solution culture method of growing plants consists of mechanically supporting the plants with their roots suspended in the nutrient solution. The continuous flow method consists of constantly adding drop by drop from a reservoir by means of a syphon arrangement. While the arrangement is simple, space does not permit its representation here. Shive illustrates the necessary material and arrangement for single cultures. Aeration is an important factor for best growth.

The seeds are germinated between several layers of cheese cloth moistened with a 1-5 dilution of nutrient or between clean white blotters in a moist chamber, and kept at a suitable temperature. A germination net is constructed as follows:

A piece of mosquito netting is dipped into melted paraffin and while still hot as much as possible of the melted paraffin is shaken out of the meshes of the net. The net is then stretched tightly over the top of an enamelware pan of convenient size and firmly secured. Culture nutrient diluted 1-5 with tap water is poured into the pan until the liquid comes in contact with the net.

After root tips have burst through the seed coat, the seeds are placed upon the net with root tips immersed in the fluid. When the seedlings are of proper size they are picked out and placed in the culture vessel containing full strength nutrient. Non-absorbent cotton placed around the stems support the plants and at the same time permit the hole in the support to be of sufficient size to accommodate the further growth. Dr. W. F. Gericke at the California Agricul-

tural Experiment Station has developed this method for large scale crop production.

Sand Culture

The sand culture method is essentially solution culture in sand. Continuous flow method with the same nutrients as used in solution culture can be used here with but slight modification. Sand is chemically inert and does not supply the mineral nutrients for plant growth. In addition to giving effective support to the plants, efficient aeration is provided. The seeds may be germinated directly in the culture pots used, or beds, or in special germinating beds, since healthy and vigorous seedlings can then be transplanted with proper spatial allowance made to prevent overcrowding. Clean white quartz sand usually precludes the presence of pathogenic fungi. Germination of seedlings is carried out as in the usual soil culture methods.

Shive and Robbins recommend highly the continuous flow sand culture method. I have seen it used most successfully at the University of Pennsylvania greenhouses by Dr. R. E. Wean (see Science N. S. 82:336, 1935, for an automatic efficient reservoir and feed system to be used for large numbers of culture pots), Mr. A. Silver and by members of the Allegheny Forest Experiments Station located there.

Subirrigation Culture

The subirrigation method of culture suitable for greenhouses is described in great detail by Withrow and Biebel of Purdue University. The system consists of a waterproof bed filled with fine gravel or cinders. The nutrients are supplied from the bottom of the bed by means of a centrifugal pump connected to a cistern placed at a level lower than the bed. The pump is operated by a time clock for three periods each day, so that at each period of operation the beds are flooded with nutrient. When the pump is turned off, the solution drains by gravity back through the pump and into the cistern.

No culture solution is complete unless it contains potassium, calcium, magnesium, nitrogen, phosphorus, and sulfur. In addition, traces of iron, boron, manganese, zinc, copper and perhaps some other elements are necessary. For average purposes, where a precise experimental study in nutritional factors is not contemplated, Shive and Robbins give the following formula:

Monopotassium phosphate ..... KH_2PO_4	5.9 grams
Calcium Nitrate ..... $Ca(NO_3)_2.4H_2O$	20.1 grams
Magnesium Sulfate ..... $MgSO_4.7H_2O$	10.7 grams
Ammonium Sulfate ..... $(NH_4)_2SO_4$	1.8 grams
	Per 5 gallons solution

The required amount of each salt is weighed out and each dissolved separately in a pint or more water to avoid precipitation. The four solutions are mixed together and enough water added to make five gallons. To these five gallons is now added not more than 10 cc. (two teaspoonfuls) of a stock solution of trace elements. The stock solution is made by dissolving in a pint of water 0.8 gram (one-quarter teaspoonful) crystals of boric acid, manganese sulfate and zinc sulfate. Since iron slowly precipitates in the culture solution, a teaspoonful of a stock solution of ferrous sulfate (0.8 gm. per pint) is added immediately before use. Wean and Silver have avoided this precipitation to a large extent by using ferric tartrate instead of the ferrous salt. Withrow and Biebel should by all means be consulted for additional formulae suitable for large scale plant production.

Plants grown in artificial culture require conditions of light, temperature and humidity similar to those required by plants grown in soil. The following bibliography abstracted from the two publications is given here so that anyone further interested in growing plants in nutrient culture may consult this pertinent literature.

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Rectal Instillations of Cod Liver Oil in the Treatment of Ulcerative Colitis. Rose Spiegel. *Journal of Mt. Sinai Hospital, New York,* through *Digest of Treatment, 1,* 6 (1937). A result of the use of cod liver oil when used locally on diseased mucous membranes in patients with ulcerative colitis is reported. A 40 per cent. emulsion of cod liver oil with acacia and water, kept cold and in colored bottles to protect the vitamin A content, was slowly instilled into the rectum. It was administered in increasing amounts and by the end of a two-weeks' treatment, eight ounces of emulsion could be retained overnight. Patients with residual lesions in the anal portion of the rectum were treated with suppositories containing 68 per cent. of cod liver oil. While none of the patients had responded to the other forms of treatment used, improvement in the condition of nine of the eleven patients under the cod liver oil treatment was observed.

H. P. F.

REPORT ON LIVER PRODUCTS

By the United States Pharmacopoeia Anti-Anemia Preparations Advisory Board

The Anti-Anemia preparations of the U. S. XI are, at the present writing, assay-orphans. The following report is illuminating in that it describes the present plan for the standardization of these products.

The standardization of products for the treatment of pernicious anemia is defined for the first time by the Eleventh Revision of the United States Pharmacopœia as follows: "Liver, stomach and other preparations used for this purpose, to be recognized as meeting the specifications of this Pharmacopœia, must be approved by the 'U. S. P. Anti-Anemia Preparations Advisory Board.' Approved products must have complied with the following specifications: 1. There shall have been submitted from time to time, as requested by the Board, satisfactory clinical data from treatment, with the product in question, of cases of Addisonian pernicious anemia. 2. The clinical data submitted shall satisfy the U. S. P. Anti-Anemia Preparations Advisory Board that the administration of the material in question, as prepared from liver or stomach, can produce a satisfactory result in the dose given."

In accordance with this requirement, the U. S. P. Anti-Anemia Preparations Advisory Board has considered data submitted by various pharmaceutical companies. In each case the response of the patient to the liver extract in question was studied particularly with respect to the reticulocyte and red blood cell production resulting from the daily administration of a uniform amount of each preparation. The nature of the preparations submitted has been either dry liver extract (Extractum hepatis), liquid extract of liver, (Liquor hepatis), or parenteral solution of liver, (Liquor hepatis purificatus), as defined in the Pharmacopœia of the United States, Eleventh Revision.

Because of the variation in the efficiency of different processes of manufacture, the therapeutic activity of the final product does not necessarily correspond to the amount of liver from which it is derived. It is therefore necessary to define the therapeutic activity of the final product in other terms. Accordingly, the board has assigned

to each acceptable preparation a value in terms of units. The amount of material constituting a "Unit" is considered to be that amount of material which, when given daily to patients with pernicious anemia, has produced a satisfactory hematopoietic response. Since in the average case material derived from about thirty times as much liver must be given by mouth to produce the same response as when given by injection, it has been necessary to define the "Unit" either as an "oral" unit or as an "injectable" unit, according to the intended method of administration of each preparation.

Accordingly, it is understood that on labels, bottles or cartons, or in advertising circulars, the manufacturer whose products have been assigned unitage by the board shall no longer state the number of grams of liver employed in making the preparation, but merely either the number of cubic centimeters or grams of material constituting a unit. Depending on the method to be used in the administration of the preparation, the unit will be defined as either an "oral" unit or an "injectable" unit. Definition of the number of units in a preparation for "oral" administration in terms of "injectable" units or vice versa is not permitted. It is further understood that if any dosage is suggested by the manufacturer, the dosage recommended should not be less than one unit a day, whether given daily or at longer intervals. The wording on the label or in the package literature concerning the unitage will give the following information: "The daily { intramuscular administration of / oral } (no.) cc. / grams (capsules, teaspoons, etc.) of material prepared by the method employed in producing the contents of this { bottle / vial / package } has been demonstrated to produce a satisfactory hematopoietic response in pernicious anemia, and constitutes a unit according to the United States Pharmacopœia Anti-Anemia Preparations Advisory Board."

In general it is recommended that, without good evidence that no harm will result, the amount of material administered should probably not be less than one unit a day, whether given daily or in multiple amounts at longer intervals. In many instances it is probable that the clinical indications will render it advisable to give the patient much more than a dosage averaging a unit a day. It must be recognized that the amount of material constituting a unit is de-

termined largely on the basis of the hematopoietic response and does not imply that such an amount is necessarily effective in the control of gastrointestinal or neural manifestations. Furthermore, there is some evidence that the effectiveness of different types of preparations, although similar when defined in terms of units with respect to blood formation, may differ in their effectiveness upon the gastrointestinal or neural manifestations. A full discussion of the indications for the administration of liver preparations is obviously outside the scope of this announcement; and through the co-operation of the American Medical Association and the Committee of Revision of the United States Pharmacopœia, a special article on this subject has been published: "The Use of Drugs in the Treatment of Anemia." J. A. M. A., November 14, 1936, vol. 107, pp. 1633-1636.

The board will, as occasion arises, re-evaluate products based on new clinical data or assign unitage to new products submitted by manufacturers and accepted by the board.

The Treatment of Canine Distemper With a Chemotherapeutic Agent, Sodium Sulfanilyl Sulfanilate. A. R. Dochez and C. A. Slametz. *Science, 87,* 142 (1938). A preliminary report is given of results obtained from the treatment, with a chemotherapeutic agent, of animals infected with the virus of canine distemper. The compound used was sodium sulfanilyl sulfanilate. This compound is a white crystalline substance highly soluble in water and of neutral reaction. It is readily absorbed by way of the gastrointestinal tract, and has little or no toxicity for small animals in doses equivalent to one gram per kilogram of body weight. Ferrets, rabbits and cats have received one gram per day for periods as long as two weeks without loss of weight, appetite or other untoward symptoms.

The therapeutic action of the drug has been tried on animals infected with the virus of canine distemper. In ferrets experimentally given this disease, sodium sulfanilyl sulfanilate has been found to have a remarkable therapeutic effect. It both prevents the development of the disease in animals treated within the incubation period, and cures the disease promptly in animals treated after the first rise in temperature and the appearance of symptoms. The action of the drug is equally efficacious whether dried living distemper vaccine

virus is used for infection or fresh virus-containing filtrate obtained from the dogs suffering from the spontaneous disease.

The experiments clearly indicate that sodium sulfanilyl sulfanilate, when administered to ferrets experimentally infected with canine distemper, both prevents the disease when given before the appearance of symptoms, and cures the disease promptly when administered shortly after the development of characteristic symptoms and fever. There is some evidence to indicate that serious secondary bacterial infection accompanying the distemper may destroy the favorable action of the drug. One treated ferret died twenty-five days after the discontinuance of the drug. At autopsy consolidated areas were found in the lungs, the exact nature of the disease not being apparent. Whether this animal died because of latent activity of the virus or was reinfected from a nearby diseased ferret is unknown.

Treated ferrets remain remarkably free from symptoms, maintain a good appetite and in general gain weight. No toxic manifestations were observed with a dosage of 1 gm. daily. When the dose was increased to 2 gms. daily, diarrhea and loss of weight appeared.

The drug was given a short clinical trial in spontaneous canine distemper in dogs. So far the effects seem to be of equal value to those observed in the experimental disease. Of twenty-eight animals treated at varying stages of the disease, twenty-six have recovered. Symptoms and fever disappear rapidly and the appetite promptly returns. The animals remain well after the cessation of treatment. One animal treated on the fifth day of the disease recovered within forty-eight hours and thereafter remained well. Of the two fatal cases one animal died and the other was sacrificed. Both were in an advanced stage of the disease when first treated and had already developed severe secondary pulmonary infection. The amount of drug administered to dogs has been 1 gm. twice daily. Eighteen cats suffering from a spontaneous disease commonly known as cat distemper or influenza have also been treated with the drug. Its effect in this condition is in all respects similar to that in canine distemper.

Sodium sulfanilyl sulfanilate therefore appears to be the first chemical agent to have such definite therapeutic action in an infection *due to a filtrable virus.* The range of its activity in virus diseases remains to be explored. L. G.

The Liquefaction of Spontaneous Tumors of the Mammary Gland in Mice by Heptyl Aldehyde. L. C. Strong. *Science, 87,* 144 (1938). Recent data have shown that certain characteristics of spontaneous tumors of the mammary gland in mice may be influenced by the daily administration of the true oil of gaultheria in the diet of those mice showing such neoplasias. These effects have to do with the clinical course and histological appearance of the tumors. It has been demonstrated that in early cases the connective tissue of the tumor seems to have been materially enhanced by such a treatment. Similar results could not be produced by the use of redistilled synthetic methyl salicylate. In an attempt to isolate the active agent of the true oil which had the above inhibitory action on spontaneous tumors, the true oil was subjected to fractional distillation. From this work, it was shown that the active inhibitory agent was contained in the low boiling point fraction, that is, in that fraction which distilled over below the boiling point of methyl salicylate. It was demonstrated that the low fraction had a pronounced effect on: (1) the slowing up of the growth rate of tumors, with complete regression in four out of thirty-four animals; (2) an increase in the survival time of the mouse after the onset of cancer, and (3) gross and histological alterations in the tumors themselves. These changes in the tumors themselves were (1) softening and in some cases (2) complete liquefaction. The action of the low fraction appeared to be more pronounced than the action of the true oil of wintergreen.

Since heptyl aldehyde is an ingredient of the low fraction, it was decided to put mice bearing spontaneous tumors of the mammary gland on a diet containing this chemical. Only that part which distilled at 152° C. was used in this experiment. A very pronounced softening and liquefaction of the tumors occurred in the mice receiving heptyl aldehyde in an otherwise normal or standard diet. Liquefaction was so extensive that drainage through a hypodermic needle under sterile conditions was easily accomplished. Six of the first twenty-five mice placed on the heptyl aldehyde treatment completely regressed their tumors. Liquefaction and regression of tumors never occurred in 120 individuals which served as controls. Samples of the drained-off liquid were tested and found to be sterile.

The present investigation is of interest, since it opens up the question that spontaneous tumors, in mice at least, may eventually be controlled by chemotherapy. L. G.

Virus Proteins—A New Group of Macromolecules. W. M. Stanley. *J. of Physical Chem., 42,* 55-70 (1938). A report of extensive experimental work and a discussion of theoretical implications of discoveries in the field of virus proteins is given. The discovery that many viruses, hitherto suspected of being submicroscopic organisms, have many of the properties of molecules has brought to light many interesting possibilities. It has been possible to obtain in crystalline form the virus protein of tobacco mosaic. It behaves in many respects as a giant molecule, having a molecular weight of several million. Several virus proteins, some from other plant diseases, and some from animal and bacterial diseases, some larger and some smaller than tobacco mosaic virus protein, have been isolated and are now under investigation. The virus proteins thus represent a new group of macromolecules which are considerably larger than those of any group of proteins hitherto described. Since the virus proteins possess virus activity and certain properties characteristic of organisms, as well as the properties of molecules, any attempt at this time to classify them definitely as molecules or as organisms should be one solely of convenience. On the basis of present knowledge, the virus proteins appear to bridge the gap between molecules and living organisms. L. A. R.

The Determination of Sulfanilamide in Tungstic Acid Blood Filtrates. E. G. Schmidt. *J. Biol. Chem., 122,* 757 (1938). Blood sulfanilamide determinations are frequently requested in the hospital laboratory since the introduction of this chemotherapeutic agent in the treatment of certain infectious diseases. The method used experimentally by Marshall and his associates (J. A. M. A., *108,* 953 (1937)) necessitates the preparation of a special toluenesulfonic acid blood filtrate. The method reported here may be applied to a routine Folin-Wu tungstic acid blood filtrate. There are many constituents in protein-free blood filtrates which react with β-naphthoquinonesulfonic acid when in slightly alkaline solution, thus furnishing the bases for the Folin colorimetric amino-acid method but none of them seems to react with this reagent when in alkaline solution. The pH of the Folin-Wu filtrates, prepared according to the Haden technic generally varies from 4 to 5 which prevents the reaction with the chromophoric reagent. Sulfanilamide in concentrations ranging from 0.01 to 0.2 mg. per 10 cc. reacts with this quinone reagent fairly rap-

idly, the final color ranging from a straw yellow to an orange red and attaining a maximum intensity in forty-five to sixty minutes. Since the color reaction with different amounts of sulfanilamide lacks good proportionality the author sets up five standards corresponding to 2, 4, 7, 10 and 15 mg. per cent. bloods and reads each filtrate against the standard which it most closely matches.

Using the values obtained by this method on bloods secured from patients undergoing sulfanilamide thereapy, the results were found to check closely with the values obtained by Marshall's diazotization method.

L. F. T.

Relative Activity of Various Purified Products Obtained From American Grown Hashish. R. P. Walton, L. F. Martin and J. H. Keller. *Jour. Pharm. & Exp. Ther., 62,* 239 (1938). Various purified products were obtained from American grown cannabis and their physiological properties studied by two assay methods; described in such a manner as to serve as a standard for other workers. The stages of motor incoördination in dogs are described. In the dog method it was found that the maximum incoördination was reached in two hours and not in one hour, as advocated by the U. S. P. X assay. The other physiological method used was based upon the corneal anesthesia produced after intravenous injection. The results of the assays are expressed in terms of a standard fluid extract. A potent oily extract was obtained from the American product which corresponded approximately in physiological activity and physical properties to the products described by European workers. The method of purification employed is described. Comparison of various methods of administration were made, showing that effects of cannabis can be noted after subcutaneous, percutaneous or intravenous administration. Subcutaneous doses of 50 mgm. of "cannabinol" produced effects similar in intensity to 1 mgm. intravenously, and 60 mgm. doses per kgm. percutaneously equalled 1 mgm. injected intravenously. Intravenous doses of 0.25 mgm. per kgm. produced definite effects in dogs, whereas intravenous doses of 50 and 100 mgm. per kgm. did not cause death. Minimum doses producing definite effect in humans ranged from 10 to 20 mgm., when administered orally. An attempt was made to determine the amount of active drug introduced by the smoking of one cigarette. Approxi-

mately 4 mgm. of active substance was found to be necessary to produce the effects of marihuana when absorbed through the respiratory passages. M. S. U.

Osmometric Study of Gum Acacia Solutions Used for Intravenous Injections. Hugh R. Butt and Ancel Keys. *J. Physical Chem., 42,* 21 (1938). The investigation shows that in the concentration usually employed for clinical use (6 per cent.), gum acacia behaves as a typical hydrophilic colloid that is highly aggregated. It exerts a colloid osmotic pressure of 18 mm. of mercury, a value that is nearly equivalent to that of the normal colloids of the plasma. In addition the authors point out that gum acacia particles readily leak through ordinary protein-tight membranes but are restrained by membranes of lesser permeability. A thorough discussion, including clinical results, of the effect of human serum on the permeability of membranes to gum acacia is included. L. J. K.

Vitamin E (Tocopherol). J. C. Drummond and A. A. Hoover. *Biochem. J., 31,* 1852 (1937). The fractionation of the unsaponifiable matter from wheat-germ oil with 92 per cent. or absolute methyl alcohol does not give such a satisfactory separation as does the chromatograph method using aluminum oxide. The purest specimen of vitamin E obtained by the authors was B-tocopherol showing an E value ($E^{1\%}_{1\text{ cm.}}$ at 296 mμ) = 79 and an iodine value of 149. An examination of its spreading properties indicated that one cross-section of the molecule was at least 8 sq. mμ while the other was less than 6 sq. mμ. The vitamin is considered to possess a sterol like structure with a long side chain. L. F. T.

Solutions for Injection. *The Pharmaceutical Journal, 3872,* 140 (1938), through *La Scienza del Farmaco, 5,* 279 (1937). Salts of camphosulphonic acid have given satisfactory clinical results in cardiotherapy, the stimulating action of the camphor complex on the nervous system, circulation and respiration being advantageous. In salts of this acid a group having a basic function is attached to a group having an acid function. The acid, in the form of large crystalline plates, soluble in water, may be prepared by adding natural camphor to a mixture of sulfuric acid and acetic anhydride, the reac-

tion being carried out at a low temperature. Quinine camphosulphonate (neutral) may be produced by the action of two molecules of camphosulphonic acid upon one of quinine. The product which contains 40 per cent. quinine and 37.7 per cent. camphor, is readily soluble in water, its aqueous solutions having an acid reaction. Quinine camphosulphonate (basic) produced by one molecule of camphosulphonic acid reacting with one of quinine, containing 56.4 per cent. quinine and 26.4 per cent. camphor, is sparingly soluble in cold water, its aqueous solutions are neutral to litmus. Notwithstanding its lack of solubility the basic salt is preferred since its solutions are neutral and it contains a higher percentage of basic quinine. The addition of antipyrine or ethyl urethane facilitates the solution of the basic quinine salt. Stable solutions of from 5 to 15 per cent. of the salt may be prepared by adding an equal quantity of these substances. Calcium camphosulphonate containing 60 per cent. camphor and 1.8 per cent. calcium prepared by the action of camphosulphonic acid on calcium carbonate is very soluble in water, its solutions are stable even when very concentrated. Solutions of 30 to 50 per cent. strength may be prepared and sterilized at 112° C. for thirty minutes. Although containing 1.1 per cent. less calcium than calcium gluconate, the author states this salt is preferred for intensive calcium medication since ampuls of large capacity are not required. Magnesium camphosulphonate formed by the action of camphosulphonic acid on magnesium carbonate is water soluble but has not been used in general medical practice. On account of its stabilizing action it may be employed in association with the corresponding calcium salt. A preparation of the three camphosulphonates is possible by the addition of antipyrine or urethane to facilitate solution of the quinine salt.

H. P. F.

Enterocrinin, A Hormone Which Excites the Glands of the Small Intestine. E. S. Nasset. *Amer. J. Physiol., 121* (2): 481 (1938). The name *enterocrinin* is proposed for a hormone which has the property of exciting the glands of the small intestine and is an important factor in the secretion of succus entericus. This hormone is now obtained free from vasodilatin from the small and large intestines of several species of animals (swine, dog, etc.). It differs from secretin in that its administration does not excite the pancreas but augments the secretion of enzymes as well as fluid. I. C.

Vitamin G and Synthetic Riboflavin. O. H. Bessey. *Jour. Nutr., 15* (1) : 11 (1938). The Sherman-Bourquin method of estimation of vitamin G is a test for riboflavin. One unit is equivalent to 2.0-2.5 micrograms of riboflavin. I. C.

The Diagnosis and Treatment of Undulant Fever. C. E. Ervin and H. F. Hunt. *J. Am. Med. Assoc., 109,* 1966 (1937). Nine cases of undulant fever recovered following therapy by intravenous mixed typhoid vaccine. Contraindications to the vaccine are arteriosclerosis, arteriosclerotic and rheumatic heart disease, hypertension and marked debility. L. G.

The Use of Zinc Peroxide in Microaerophilic Infections. J. E. Rhoads. *Surgery, 2,* 937 (1937). Two typical cases of chronic undermining ulcer due to microaerophilic hemolytic streptococci healed rapidly after the use of zinc peroxide. Zinc peroxide introduced into the large bowel has proved useful in a case of perectal abscess associated with a nonhemolytic anaerobic streptococcus.

L. G.

The Preservation of Bacteria Dessicated in a Vacuum at Room Temperature. N. P. Sherwood and L. L. Coriell. *J. Kansas M. Soc., 38,* 506 (1937). Most pathogenic bacteria can be preserved in a viable state over long periods of time by desiccation in a vacuum at room temperature. The following are to be observed: 1. Cultures are to be grown under optimum conditions. 2. Adequate amounts of sediment for desiccation. 3. Development of a vacuum of 2 mm. of mercury rapidly. 4. Rapid desiccation. 5. Storage in desiccator overnight. 6. Storage in sealed tubes in dark. 7. The planting of optimal amounts of desiccated bacteria or in favorable culture media for recovery. 8. The tubes used for desiccation should be chemically clean and free from traces of deleterious substances.

L. G.

Pneumonia Statistics. Metropolitan Life Insurance Co. *Statistical Bull.* (Nov., 1937). Pneumonia accounts for more than 100,000 deaths a year in the United States, a number of deaths greater than that from any other communicable disease, and 1.5 times that from tuberculosis. Pneumonia is also a contributing factor in

many thousands of deaths annually allocated to other causes. It is an important factor in mortality tables throughout the entire range of life. L. G.

Mandelic Acid. Am. Med. Assoc., Council on Pharmacy and Chemistry. *Jour. Am. Med. Assoc., 109,* 1989 (1937). The Council voted to accept mandelic acid for inclusion in new and non-official remedies on the basis of reports in the literature of the therapeutic value of mandelic acid in uncomplicated urinary infections, especially of bacillary origin. The toxic effects of the drug, as reported by several workers, do not seem of sufficient intensity or duration to contraindicate its cautious use under medical supervision.

Details concerning its use, action, etc., are given. The usual dosage is 3 grams four times daily as the free acid or sodium or ammonium salt. L. G.

Fundamentals of Serum Therapy. W. H. Tucker. *Illinois M. J., 72,* 494 (1937). The greatest value of serum therapy either for therapeutic use or prophylaxis are diphtheria, scarlet fever, meningococcic meningitis, pneumococcic pneumonia, bacillary dysentery, tetanus and snake bites. The use of human convalescent serum in products used in the diseases previously mentioned is discussed.

L. G.

The Preservation of Concentrated and Fresh Infusions. I. The Application of Heat and Alcohol. K. Bullock and C. J. L. Elsdon. *Quart. J. Pharm. Pharmacol., 10,* 413 (1937). Preserved or concentrated infusions are not as good as freshly made infusions. If it is necessary to store infusions, the following methods in order of importance are recommended: (a) Fresh infusions rendered sterile by boiling or autoclaving, and stored and removed aseptically; (b) concentrated infusions made with water, rendered sterile by boiling or autoclaving, stored and removed aseptically; (c) concentrated infusions preserved with the minimum amount of alcohol should be in the following percentages for the infusions given: For concentrated infusions of clove and senna, alcohol (10 per cent.); for all other B. P. concentrated infusions, alcohol (15 per cent.). Fresh infusions of quassia and calumba should be boiled after preparation. The same procedure could with advantage be used for fresh infusion of senna.

L. G.

The Detection of Vegetable Gums in Dairy Products. P. A. Racicot and C. S. Ferguson. *J. A. O. A. C. 21,* 110 (1938). The use of vegetable gums in dairy products has been increasing within the past few years. This led the authors to undertake a study relative to the detection of such substances which is reported as follows:

To 10 grams of the sample add 10 cc. of distilled water, mix thoroughly, and add 5 cc. of 20 per cent. trichloracetic acid solution. Shake 1 minute and filter. To 1 volume of the filtrate in a test tube add 2 volumes of 95 per cent. alcohol and mix. If the resulting mixture fails to show a distinct precipitate or turbidity after standing thirty minutes the test is negative. The appearance of a stringy or flocculent precipitate indicates the presence of locust bean gum or gum tragacanth. A turbidity that persists even after standing overnight is due to decomposition products present in the sample and not to the presence of gum. If the preliminary test indicates the presence of vegetable gum, proceed with the confirmatory test as follows:

To 100 grams of the sample add 100 cc. of water, and mix well; add 50 cc. of 20 per cent. trichloracetic acid, shake for one minute and filter. To the entire filtrate add 2 volumes of 95 per cent. alcohol. Mix thoroughly and let stand overnight, preferably in a tall cylinder or graduate.

Decant the supernatant liquid as completely as possible without loss of precipitate so that not more than 50 cc. remains. Mix the precipitate with the remainder of the filtrate and pour into a 50 cc. centrifuge tube. Centrifuge five to ten minutes, pour off supernatant liquid and wash similarly with six 50 cc. portions of 75 per cent. alcohol, shaking well, centrifuging and draining the supernatant liquor as completely as possible each time to remove all traces of lactose.

Add to the entire precipitate 15 cc. of distilled water and mix. Note whether the precipitate is soluble or whether it forms merely a suspension in water. If it dissolves gum arabic is indicated and may be identified by U. S. P. tests on this solution. To prove the absence of lactose, conduct Benedict's qualitative test upon this mixture using 8 drops of the mixture and 5 cc. of Benedict's solution. Conduct the Biuret test on 1 cc. of the mixture to prove the absence of protein and the Molisch carbohydrate test on 1 cc. to prove that the precipitate is a carbohydrate.

Hydrolize 10 cc. of the mixture with 10 cc. of HCl (1 vol. conc. HCl + 2 vol. water), boiling gently two to three minutes. Cool, and neutralize exactly to phenolphthalein with NaOH using 50 per cent.

NaOH at first and finally adjusting the reaction to exact neutrality with 0.1N. NaOH or 0.1N. HCl. Cool and add 1 to 2 grams of decolorizing carbon; shake and filter.

Conduct Benedict's qualitative test upon 8 drops of this filtrate and let stand overnight if there seems to be no immediate reduction.

A negative test for protein plus a Molisch carbohydrate test and a negative Benedict test before hydrolysis followed by a positive Benedict test after hydrolysis are proof that a vegetable gum is present.

An osazone test may be performed on the neutralized solution comparing the product with that produced by the sugars resulting from hydrolysis of known gums. Glucosazones are a characteristic of locust bean gum; tragacanth gives flat pale yellow osazones resembling maltosazones and gum arabic gives very small burr-like crystals.

L. F. T.

Japanese Tea-Seed Oil. *The Chemist and Druggist, 128,* 3021 (1938). The production of tea-seed oil from Camellia japonica L., Camellia sasanqua, Thmub., and Camellia theifera has increased considerably of late due to modern methods of production. The first two mentioned varieties produce seeds which contain from 30 to 35 per cent. of pure oil. Camellia theifera is cultivated in Oshima Island, Japan and in this country tea-seed oil is known as Tsubaki oil.

Tea-seed oil expressed in China on a considerable scale is used as an edible oil after first removing the saponin. The oil, which is straw-colored, closely resembles olive oil in its characteristics except those of its unsaponifiable matter.

The Japanese oil produced in modern oil mills, in which the whole process is said to require less than one hour, is said to contain less than 0.1 per cent. of free acid as compared with 44 per cent. when produced by the old method. The oil cake now finds use in the cosmetic field by Japanese manufacturers in shampoos and similar products.

Tea-seed or Tsubaki oil is considered to be the rarest and most expensive of all commercial vegetable oils. H. P. F.

The External Use of Aloes. J. E. Crewe. *Minnesota Medicine, 20,* 10 (1937). The results of the use of aloes in an ointment and in the powdered state in ulcerated conditions, in eczema, in ivy poisoning

and in the treatment of burns is reported by the author. The gelatinous surface of the split leaves of Aloes when applied in a painful and annoying case of palmar eczema caused healing of the lesions after four successive applications. When the split leaves of the plant were applied to ulcers on the stumps of the legs of a patient the pain practically subsided and edema was much reduced after twenty-four hours of treatment. Small ulcers healed in about two weeks, while a larger ulcer which had not responded as quickly to the aloes treatment was then treated with hot packs, scarlet red ointment, balsam of peru, calamine ointment and zinc oxide ointment. The size of the ulcer seemed to increase and healing had stopped, but further applications of aloes ointment and powdered aloes resulted in the ulcer being completely healed.

In the seven cases of pruritus vulvæ which were treated with aloes, five responded satisfactorily and promptly.

When aloes ointment was used in a case of ulcers of advanced mammary carcinoma, the discharge and odor were controlled in a few days.

In treating a case of ivy poisoning aloes ointment was applied to the thigh of the right side of the patient, while solution of permanganate of potash was applied to the left side. On the side to which the ointment was applied the discomfort subsided more quickly and the condition cleared up more readily than the side on which permanganate was used.

Liberal applications of aloes ointment to a severe burn from boiling water reduced the pain, no infection developed, and the patient returned to work nineteen days after the accident occurred.

Unfavorable effects from aloes were experienced in three cases. In one case catharsis was present for one day, the author states. Due to possible absorption, aloes probably should not be used on mucous surfaces except with caution. In two cases of psoriasis there developed what appeared to be allergic erythemia bordering the original patches.

The ointment used in these cases consisted of Socotrine aloes 4 gm., Calamine 4 gm., White Petrolatum 30 gm. The Calamine was added to make the ointment more adherent.

The author concludes that fresh aloes and aloes ointment appears to relieve pain, burning and itching; have some antiseptic action; stimulates the rapid granulation and formation of new tissue; is effective in eliminating the foul odors accompanying infection. H. P. F.